CHAPTER 6

Using Applied Behavior Analytic Instructional Strategies

KEY TERMS

Baseline Data
Blocking
Collective Trials
Discriminative Stimulus
Distributed Trials
Fading
Generalization
Intertrial Interval
Massed Trials
Prompts
Prompt Dependency
Response Maintenance
Satiation
Stimulus Generalization

❖ LEARNING WITH MS. HARRIS: Ms. Nelson Finds a Cure

Ms. Harris had just finished reviewing the day with her students. As they lined up at the door to leave, Andy's mom, Ms. Nelson, rushed into the room waving a piece of paper. "Ms. Harris! Look what I just printed from the Internet! It's about the cure for my son!" Ms. Harris greeted Andy's mother and scanned the paper, stifling a sigh. Which one of the many empty promises could it be? But she knew that if she were the parent of a child with ASD, she would be drawn to any treatment that offered hope.

The website did indeed promise a cure for ASD! This particular site lauded the virtues of "ABA." Only the creators of the website weren't using the term to refer to the principles of the science of applied behavior

analysis. As in so many websites, books, and daily discussions, the term was being used to refer specifically to Discrete Trial Training (DTT). The paper documented links to curricula and techniques as well as contact information for specially trained people who could provide the miraculous intervention.

"Can you do ABA?" asked Andy's mother. "Oh, boy," Ms. Harris thought to herself. "I am using applied behavior analytic instruction every day with Andy. How do I explain to Ms. Nelson the difference between ABA and DTT?"

Arguments about the use of applied behavior analysis (ABA) for students with Autism Spectrum Disorders have consumed vast amounts of time, effort, and professional resources. Most of those arguments are not actually about ABA, but about whether or not an applied behavior analytic strategy called *Discrete Trial Training (DTT)* can enable children with ASD to achieve normal educational and intellectual functioning as described by Lovaas (1987). The effectiveness of interventions based on the science of ABA is supported by copious research, and these are considered by many to be the only scientifically validated approaches for students with ASD. However, these interventions encompass much more than just DTT.

This chapter describes and defines ABA and then explains DTT within ABA's broader context. It also covers the general approach for conducting DTT and provides examples of applied behavior analytic strategies shown to be effective with students on the autism spectrum.

APPLIED BEHAVIOR ANALYSIS DEFINED

ABA takes an empirical approach to promoting learning and development. Principles and procedures known to affect learning and skill acquisition are used to promote enhanced functioning in a measurable way. Many of these principles and procedures have been recognized by social scientists for centuries, but it was not until 1968 that a group of researchers applied the principles as defined by Skinner (1953) to socially significant human behavior and articulated the key dimensions of ABA.

In 1968, Baer, Wolf, and Risley, in the first issue of the *Journal of Applied Behavior Analysis*, described ABA as "the process of applying sometimes tentative principles of behavior to the improvement of specific behaviors, and simultaneously evaluating whether or not any changes noted are indeed attributable to the process of application—and if so, to what parts of the process" (p. 91). In this article and in a subsequent reanalysis in 1987, the authors defined the five dimensions that must be present in an intervention for it to be considered ABA. These dimensions are:

- Applied and effective
- Technological
- Behavioral
- Analytic and conceptual
- Generality

Applied and Effective

For any procedure to be considered ABA, it must make a meaningful difference in the life of the person receiving the intervention. This means that the goals of the intervention must be important to the individual and that any changes must result in a better quality of life (Wolf, 1978). The dimension of applied and effective is ascertained though an analysis of goals, procedures, and outcomes.

Goals. The goals of the intervention must be viewed as worthwhile by the individual receiving the treatment and by those making decisions about the quality of life for the person receiving the treatment. The goals should take into consideration what would lead to more independence for the individual as well as what meets societal norms for behavior.

For example, it would not be meaningful to create a goal for a kindergarten-aged student who is decoding on the third-grade level to decode on a fourth-grade level if that student is not toilet trained, does not initiate social interactions, and comprehends only on the preprimer level. According to the applied and effective dimension of ABA, goals for this student need to address areas of self-help, social initiations, and comprehension of written material. Such goals would promote the student's independence and emphasize behaviors that allow the student to access a broader range of environments.

In regard to goals, we ask: **Will the specific behavioral goals benefit the student, and are the goals valued by the community?**

Procedures. The procedures used in an intervention must be only as intrusive or invasive as the context warrants (Green, 2001). Applied behavior analysts would challenge the idea that the end justifies the means. For example, the teacher could stop students who are talking out by slapping them each time they open their mouths. However, others might not be in favor of such an aversive procedure (Durand, 2005). The use of reinforcement to shape students' behavior so that they raise their hands and wait to be acknowledged before speaking is more likely to be perceived as acceptable.

It must be noted that some individuals are subject to invasive procedures such as restraint or contingent electric shock. However, these situations are exceptions rather than the rule. The use of aversive procedures is appropriate only after all other options are exhausted and human protection clearances are obtained.

In addition to being ethical, the cost and practicality of procedures must be reasonable for the desired outcomes. In regard to procedures, we ask: **Are the procedures as minimally invasive as possible, and would other people consider them acceptable in terms of the outcome?**

Outcomes. Successful outcomes are those viewed as valuable by all involved and any unexpected negative outcomes are tolerable. For example, the use of some procedures that result in a student being able to touch body parts on

command might also provoke an aggressive reaction. Identifying body parts may be a meaningful outcome for the student, but it is not acceptable that the student hits the person asking him to identify the body parts. So, while the intervention provided some benefit, it would be worthwhile to consider if there is an alternative that does not produce undesirable outcomes.

The most common way to document the acceptability of outcomes is to consider social validity (Wolf, 1978). Social validity measures the degree to which the student and/or those who interact with the student are satisfied with *all* the outcomes and procedures used in the intervention.

Some students are unable to verbally describe their satisfaction with the outcomes. However, analysis of their behavior can provide an indication of their satisfaction. Likewise, surveys of family members, teachers, therapists, peers, and others can provide indications of satisfaction with procedures and outcomes.

Sometimes interventions actually affect the persons providing the intervention more than the recipients. For example, interventions that take place over many hours, days, or weeks can seriously disrupt the lives of family members, as in the case of a parent who quits a job to provide an intervention. Although the intervention may produce some desirable outcomes, the cost to the family may not be worth the effort, especially if there are other ways to accomplish similar goals.

In regard to outcomes, the question is: **Are *all* the outcomes and procedures acceptable in improving the quality of life for everyone involved?**

Although many published research studies meet the dimension of applied and effective for individuals with ASD, citing a few across several decades provides examples of the breadth of the meaningful differences that have been targeted. These include increased engagement and social interactions (Garfinkle & Schwartz, 2002; Kamps et al., 1992; Krantz & McClannahan, 1998; Massey & Wheeler, 2000; Pierce & Schreibman, 1997; Reinhartsen, Garfinkle & Wolery, 2002), learning new skills such as self-help, communication, and socialization (Brady, Shores, McEvoy, Ellis, & Fox, 1987; Matson, Taras, Sevin, Love, & Fridley, 1990; Ross & Greer, 2003; Yoder & Layton, 1988), maintaining appropriate levels of behavior through self-control and self-monitoring (Shearer, 1996; Strain, Kohler, Storey, & Danko, 1994), generalizing skills learned (Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998; O'Neill & Sweetland-Baker, 2001; Ross & Greer, 2003), reducing the number of environments in which challenging behavior occurs (Carr, Dozier, Patel, Adams, & Martin, 2002), and decreasing interfering behaviors such as self-injurious behaviors, stereotypies, aggression, tantrums, pica, grabbing, spitting, inappropriate touching, and destroying property (Carr & Durand, 1985; Wacker et al., 1990).

Technological

To be considered ABA, interventions need to use technologies (strategies) that have been shown to be effective for learning and behavior change in all

animals, including humans. The learning principles that underlie most of these technologies are centuries old and date back to times when the principles were used intuitively. Today, of course, they are defined and studied.

For example, it is reported that ancient Romans put eels in the bottom of wine cups to discourage excessive drinking, and monks in A.D. 610 gave out little dough scraps baked in the shape of praying hands (pretzels) to encourage children to learn their prayers (Alberto & Troutman, 2003). Most technologies used in applied behavior analytic approaches derive from operant learning theory, which has verified that behavior is occasioned by what occurs before the behavior (antecedent) and is influenced by what follows the behavior (consequence) (Skinner, 1953). It would take volumes to define and describe all of the validated technologies, so instead three procedures will be described as they relate to learning: reinforcement, prompting, and discrete trials.

Reinforcement. Operant learning theorists define *reinforcement* as anything that follows a behavior that maintains or increases the occurrence of the behavior. As such, there are no universal reinforcers. For some students, praise for completing a task increases or maintains task completion. For other students, praise does neither, but instead reduces the number of tasks completed. In that case, praise is not reinforcing; it is punishing.

One of the great behavioral challenges is the recognition that reinforcement is not a "thing" but an effect. For example, if cheese crackers are used to increase the number of times a student will sit down when directed to do so by the teacher, and the number of times the student sits down increases, then cheese crackers are reinforcing. If the number of times the student sits down decreases, then cheese crackers are not reinforcing. People who make statements such as, "In-seat behavior is not increasing even though I'm reinforcing the student with cheese crackers" do not really understand the technology of reinforcement.

For students with ASD, it is documented that sensory activities and access to objects of obsession may be as effective as food or praise (Charlop-Christy & Haymes, 1998; Ferrari & Harris, 1981) and may even produce higher numbers of correct responses than other types of reinforcement (Rincover & Newsom, 1985). Indeed, the opportunity to engage in self-stimulatory behaviors can serve to increase acceptable behaviors (making it a reinforcement; Hung, 1978), without increasing the number of self-stimulatory behaviors in other contexts (Charlop-Christy & Haymes, 1998; Wolery, Kirk, & Gast, 1985). Even when the reinforcer is delivered less frequently, individuals with autism continue to use the skills that were learned (Dunlap, Marshall, Plienis, & Williams, 1987).

Prompting. **Prompts** are additional supports that increase the likelihood that a behavioral response is learned. For example, when teaching young children to write their names, adults sometimes put their hands over the children's hands to guide them through the movements. This hand-over-hand guidance is a prompt.

ABA technology uses various types of prompts and includes several ways of implementing them. For students with ASD, some of these are tactile prompts (i.e., a pager-like device that vibrates) that help increase verbal initiations (Shabani et al., 2002; Taylor & Levin, 1998), picture prompts to increase ability to follow routines (Hall, McClannahan, & Krantz, 1995), written and audiotaped scripts that help promote more elaborate verbalizations (Krantz & McClannahan, 1998; Stevenson, Krantz, & McClannahan, 2000), video modeling that helps teach conversation skills (Charlop & Milstein, 1989) as well as purchasing (Haring, Kennedy, Adams, & Pitts-Conway, 1987), and self-operated auditory prompts that help increase academic and vocational on-task behaviors (Tabor, Seltzer, Heflin, & Alberto, 1999).

Prompts can increase the rate and accuracy of learning skills, but they may also cause dependency (i.e., the student waits for the prompt before engaging in the behavior). For this reason, the technology includes specific suggestions for fading prompts.

Discrete Trials. A trial is the basic unit of instruction. It presents a structured opportunity for a student to respond in the presence of a particular antecedent and consequence (Heflin & Alberto, 2001). Discrete Trial Training (DTT) is covered more thoroughly later in this chapter, but it is important to highlight that the discrete trial is just one of a number of technologies used in ABA.

Behavioral

This dimension takes a functional view of behavior, asserting that behavior always occurs for a reason, and the reason is directly related to the environments where the behavior occurs. Understanding the influence of context on behavior often leads to developing interventions that include changes in the environment (Dunlap, Kern, & Worcester, 2001) and an appreciation of the function(s) the behavior serves (Johnston & O'Neill, 2001).

Everyone behaves in ways that maximize gain and pleasure and minimize loss and pain. The desire to experience certain consequences and avoid other consequences is directly related to the environmental context. For example, students study and complete assignments in order to get good grades and avoid failing. Similarly, people brush their teeth to preserve them and avoid getting cavities.

Identifying what students want or do not want in a specific context is crucial to developing effective interventions. To do so involves conducting a functional behavior assessment (FBA), described in more detail in Chapter 7.

Analytic and Conceptual

This dimension of ABA regards accountability and being able to demonstrate that the interventions used are responsible for the learning of new skills and other changes in behavior. To link student outcomes to instruction and

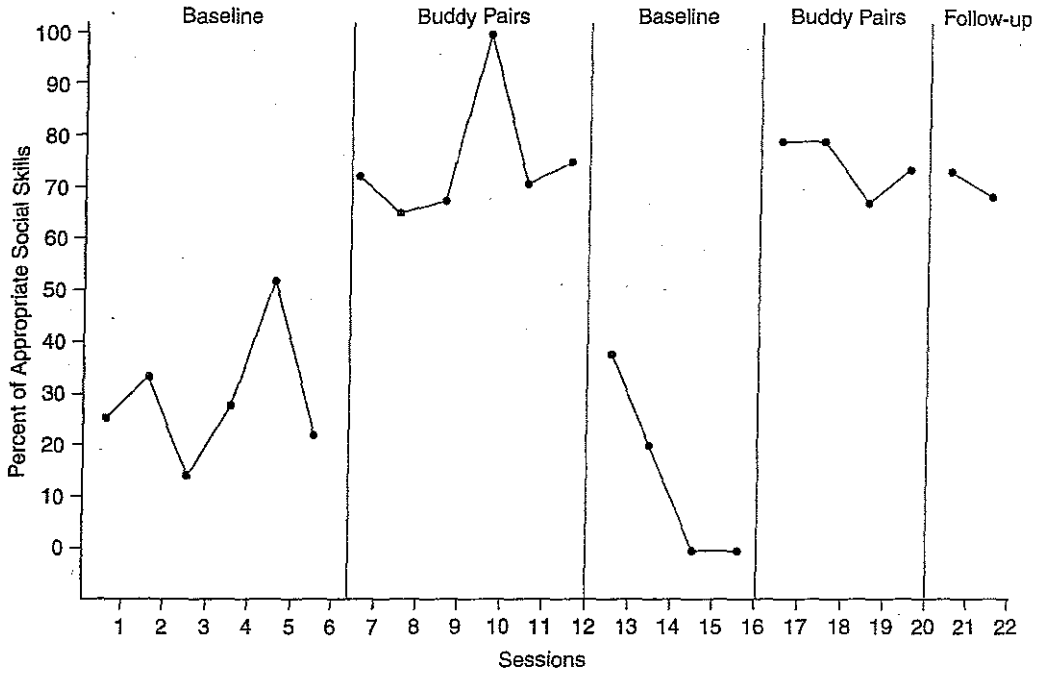

FIGURE 6.1
ABAB Design

Source: Kluwer Academic Publishers, *Journal of Autism and Developmental Disorders, 30,* 2000, p. 189, Enhancing social skills of kindergarten children with autism through the training of multiple peers as tutors, K. M. Laushey & L. J. Heflin, Figure 1, © 2000. With kind permission of Springer Science and Business Media.

interventions requires collecting data on behaviors that are observable and measurable, and the data must be collected frequently enough to be useful in evaluating the instruction and interventions.

In ABA, the methodology used to analyze data for instructional decision making is typically presented in single-subject designs that allow conclusions to be drawn from the data. There are two types of single-subject designs. "Teaching designs" allow conclusions to be drawn about whether the measured behavior is changing. "Research designs" demonstrate that the changes in behavior occur as a result of the intervention (Kennedy, 2005). Figure 6.1 displays a research design graph.

Both teaching and research designs present **baseline data** first, which are data collected prior to an intervention (usually referred to as the A phase). During intervention, data continue to be collected and are recorded as the B phase. With two phases, a teaching design called the *AB design* is being used.

An example of using an AB design is with a student who is initiating few interactions with his peers. The teacher targets a time when initiations could occur, such as at lunch, and collects baseline data to verify that the number of initiations is low. On Monday during lunch the student made 0 initiations; on Tuesday, 1 initiation; on Wednesday, 0 initiations; on Thursday, 0 initiations; and on Friday, 2 initiations. Given that other students in the same class initiate interactions an average of 12 times during lunch, the teacher decides to implement an intervention to increase the number of student initiations.

As the teacher continues to collect and graph data on the behavior during the intervention, the data show an increase in the number of initiations. Although it is impossible to conclude that the behavior is changing because of the intervention (which is why this is a teaching design), it is possible to document a behavioral change. If the number of initiations increases slightly but is still below the average number for the peers, the teacher may change something about the intervention to see if the number of initiations can be increased further. At this point, the AB design becomes an ABC design because there are two interventions: the first one (B) and the second one (C).

A visual inspection of graphs from teaching designs may confirm that there is behavioral change, but the design used cannot guarantee that the change occurred because of the intervention. A research design must be used to demonstrate that the behavior changed because of the intervention. There are several to choose from, including the ABAB (withdrawal) design that was shown in Figure 6.1.

In the ABAB design, if the intervention results in the desired behavior change after the first AB, the intervention is withdrawn to see if the behavior returns to baseline levels (second A). If so, the intervention is reinstated to determine if the behavioral performance improves (second B). If the baseline phases (the A phases) result in about the same levels of behavior, and the intervention phases (the B phases) produce the same levels of behavior, there is a demonstrated functional relationship between the intervention and the performance. Such is the case with the graph shown. John had a higher percentage of appropriate social skills when he participated in an intervention in which typically developing kindergarten children were taught to engage children with autism as compared to the baseline conditions (no intervention).

This graph provides visual evidence that not only was the intervention effective (the percentage of appropriate social skills used by John was much higher when the buddy-pair intervention was in place), but it was also responsible for the changes in the demonstration of social skills (when the intervention was removed, the percentage of appropriate social skills decreased). The graph also shows that when follow-up data were collected for John during the first six weeks of his next school year, the percentage of appropriate social skills was still much higher than during the baseline period. The concept of maintenance across time is important and will be discussed more fully in the section on the final dimension of ABA, generality.

The other research designs used to demonstrate a functional relationship between intervention and behavior as well as various data collection techniques will not be described here. Kennedy (2005) provides complete descriptions of both teaching and research single-subject designs and data collection techniques. Suffice it to say that data must be collected and analyzed for an intervention to be considered ABA. Although analysis usually occurs through a visual inspection of graphed data, other methodologies are available for linking changes in behavior to interventions.

Group designs compare the results of a group of students who receive a treatment to a similar group of students who do not receive the treatment (Kazdin, 2001). Group designs are not used as frequently with students with ASD because the population is so heterogeneous. Whether using the results of single-subject designs or group designs, analysis of data creates a self-correcting feedback loop for applied behavior analytic interventions (Anderson & Romanczyk, 1999). If data do not show desired changes in behavior, the intervention should be discarded or modified.

Generality

In a now classic statement, Baer, Wolf, and Risley (1968, p. 97) wrote, "Generalization should be programmed, rather than expected or lamented." This dimension of ABA suggests that even with a socially valid goal, appropriate techniques that consider the environmental context of behavior, and a research design that demonstrates the intervention is responsible for changing behavior, the intervention does not meet all the dimensions to be considered ABA if the student doesn't demonstrate the behavior outside of the teaching setting.

Generality (or **generalization**) means that the skills learned in teaching situations are then used in nonteaching situations. For example, if a student reliably responds to only one person who asks, "What's your name?" but does not respond if anyone else asks the same question, then the student has failed to generalize the skill. Unfortunately, individuals with ASD are characterized by their inability to generalize. They may not use a skill learned in the classroom in other situations, even other classrooms. Or they may not use the skill with people other than the person who taught them the skill. These are issues of **stimulus generalization** (Anderson & Romanczyk, 1999; Heflin & Alberto, 2001) in which new stimuli (places or people) do not occasion the behavior that is reliably demonstrated in the teaching situation. Fortunately, there are a number of strategies for promoting stimulus generalization. These include teaching the behavior using a variety of instructions (e.g., "What's your name?" "Who are you?" "Are you Steven?") as well as using a variety of materials to teach concepts, having different people provide the instructions, and conducting the instructional interactions in different settings.

Stimulus generalization is also enhanced by gradually withdrawing any prompts that have been introduced (known as **fading**), shaping the controlling stimuli so that more natural ones precede the desired behavior

(e.g., gradually change from "Steven, go stand by the door" to "Steven, go line up" to "Everybody line up" to "It's time to go"), and practicing the behavior in natural environments with natural contingencies (e.g., standing in line in the cafeteria so you can get your food).

Another type of generalization is response maintenance. **Response maintenance** occurs when students continue to use a skill across time and across contexts, even when the teacher does not practice it with them on a frequent basis. It is not uncommon to lose a skill when it is not practiced. For some individuals on the autism spectrum, the amount of time it takes to forget a skill is short. For this reason, ways to promote response maintenance must be incorporated into instructional planning.

Specific strategies are effective for promoting response maintenance. Practicing the skill at various times across several days can promote response generalization (Anderson, Taras, & Cannon, 1996). Pairing primary reinforcers (e.g., food, drink) with secondary reinforcers (e.g., praise, smile) can help teach the value of the secondary reinforcer since those are the ones that tend to occur naturally (Alber, Heward, & Hippler, 1999). Likewise, gradually and systematically reducing the use of primary reinforcers and the frequency of reinforcement ("thinning of reinforcement") can also promote generalization across time (Skinner, 1969). This dimension of ABA requires that strategies for facilitating stimulus generalization and response maintenance be considered in the development of instructional interventions.

SUMMARY OF APPLIED BEHAVIOR ANALYSIS

ABA is a theoretical framework for promoting behavioral change, not a specific technique. The principles of ABA have been used effectively to teach everyone, not just those with ASD. There are many applied behavior analytic interventions. To be considered an applied behavior analytic intervention, the five dimensions articulated by Baer, Wolf, and Risley (1968; 1987) must be present:

- Socially significant behaviors are changed to a meaningful degree by using acceptable techniques with demonstrated effectiveness.
- The intervention must consider the influence of the environment on the behavior and must incorporate techniques designed to promote the continued use of the skill with other people and in other environments.
- Collected data must be analyzed to demonstrate that the instructional intervention is responsible for the change in the behavior.

Some applied behavior analytic interventions are stronger in regard to some dimensions than other dimensions, but all five dimensions need to be present for the intervention to be considered ABA. Confusion emerges when people use the term *ABA* to refer to a specific methodology, not the broad theoretical framework. This is what happened to Andy's mother in the vignette that opened this chapter, when she stumbled onto a misapplication of the term on the Internet. The website she found uses the term *ABA* to refer to a specific methodology, not the theoretical framework. Ms. Harris's

response to Ms. Nelson, inquiring if she can "do ABA," should be that she incorporates the dimensions of ABA in her instruction every day. What was actually being discussed on the website Ms. Nelson found was Discrete Trial Training (DTT) rather than ABA.

DISCRETE TRIAL TRAINING

A discrete trial is a basic unit of instruction that falls under the technological dimension of ABA. DTT refers to the "intensive application of ABA principles within a structured teaching environment to teach specific skills" (Frea, 2000). For the population of individuals with ASD, DTT was first studied intensely to determine effectiveness for teaching expressive language (Lovaas, Berberich, Perloff, & Schaeffer, 1966; Lovaas, Freitag, Nelson, & Whalen, 1967). Using discrete trials, speech sounds were shaped into words to label objects. Today, however, a glance at any one of the published DTT curricula reveals that DTT is used to teach a variety of imitation, communication, socialization, and compliance skills (Leaf & McEachin, 1999; Lovaas, 2003; Maurice, Green, & Foxx, 2001; Maurice, Green, & Luce, 1996; Sundberg & Partington, 1998). The carefully modulated trials, which emphasize rote learning, can be effective for acquiring skills. Indeed, most people learn basic "facts" (e.g., multiplication tables, friends' names, telephone numbers) through what is essentially DTT.

The goal of DTT is to teach students to respond when directed, but not to respond if not directed ("stimulus dependency"). Chapter 4 defined a stimulus as something that occasions a particular response. Stimulus control means that the same behavioral response occurs whenever the stimulus is present. For example, if students are under stimulus control, they will comply with the directive, "Line up!" as quickly as it is given. Stimulus dependency means that students will not get in line unless the teacher directs them to do so. The behavioral response (getting in line) depends on the stimulus of the teacher's words.

There are a number of variations on DTT. For the purpose of introducing the methodology, DTT will be described as occurring in five steps. Although DTT has been divided into as few as three or as many as eight steps, all discrete trials contain the same basic components. The basic components for conducting DTT are:

- Attention
- Presentation of stimulus
- Student response
- Feedback
- Intertrial interval

Attention

To establish stimulus dependency, the student needs to attend to the stimulus. To begin a trial, the student's attention must be captured or he may miss

the stimulus. Typically, the teacher is in close proximity to the student and may say the student's name, make eye contact, touch the student, or hold up something that attracts the student.

There are important things to consider in gaining the student's attention. Whatever is done should be effective the first time. For example, say the student's name only if it is known that she will orient to the speaker. Adults, unfortunately, teach children at an early age to ignore talking. Children playing outside rarely come inside for dinner the first time they are called. Most ignore the directive until the caregiver uses the first, middle, and last names in a shrill and no-nonsense tone, at which point they scurry inside the house. The same phenomenon occurs in many classrooms today. Teachers often have to make several requests with a concomitant change in tone and volume before everyone in the class complies with the direction given.

It may be best to avoid using the student's name every time to get attention. In the real world, directions are not always prefaced by names. Always using the student's name may inadvertently teach the student not to attend unless he hears his name. For initial discrete trials, holding up something the student likes, such a toy or a favorite food, may result in the student attending very intently.

In choosing a stimulus, it is important to remember that students with ASD are frequently reluctant to make eye contact. As discussed in a previous chapter, individuals with ASD can become overwhelmed by sensory input. For a student with ASD, looking at other people's faces, particularly their eyes, can result in a high level of sensory stimulation. They may instead rely more on peripheral vision (looking out from the sides of their eyes) to reduce the amount of visual input. Sometimes, a student on the autism spectrum may give full attention when she is beside the teacher using her peripheral vision, but not make direct eye contact. In fact, the absence of eye contact may increase the likelihood that she will pay more attention to what is being said. One high-functioning adult with autism has indicated that she can either make eye contact or listen, but not both, because the amount of sensory stimulation becomes too overwhelming (Grandin, 1996). Before presenting the stimulus, use whatever strategy gains the student's attention the first time.

Presentation of Stimulus

After gaining attention, give the instruction or direction. The technical term for the instruction is **discriminative stimulus.** This is what informs the student that a particular response is expected. For example, most people will say the discriminative stimulus for getting up in the morning is the sound of the alarm clock. However, how many people get up when the alarm clock goes off? Most will say that the actual discriminative stimulus for getting up is a certain number of hits on the snooze button or a specific time on the clock. In DTT, the discriminative stimulus for the student's response is determined in advance, remembering that the discriminative stimulus will be

learned more quickly if it is the same every time (consistent); doesn't contain too much information (concise); and specifies exactly what needs to occur (clear).

An example of an inappropriate discriminative stimulus would be for a teacher to say, "Why don't you come over here and sit in this blue chair next to me?" An appropriate discriminative stimulus that provides the same information but is clear and concise is, "Come sit." To establish stimulus control, those exact words would be used every time. To prevent teaching students to ignore the discriminative stimulus, give it only once and say nothing else.

Student Response

After presenting the discriminative stimulus, wait for the student's response. There are only three responses possible: correct, incorrect, or no response at all. In DTT, the teacher should carefully consider how to maximize the likelihood that the student will respond correctly. One way is to engineer the environment so that there are few distractions and to be in close proximity so that the student can be quickly redirected if he tries to leave the area. Another is to make sure that the behavior selected for the trial is within the student's repertoire.

For example, if the student likes to throw things, the teacher might say "Open box" while holding out a box containing a lid. The student may reach for the box to throw it, but the teacher is holding the box tightly enough so that the student can grab only the lid, which he throws. Because the discriminative stimulus was to open the box, the student has responded correctly. Later, the student's behavior can be shaped so that he places the lid on the table after removal. The important concept is that the behavior is one that the student has the potential to perform, and the environment, including how materials are presented, is carefully engineered to enhance the probability that the correct stimulus will be attended to and the correct behavior will occur.

Even with careful selection of the behavior and good instructional control, the student may not respond with the correct behavior. He may instead engage in another behavior such as waving his hands in front of his face or talking about a favorite movie. He may try to leave the area. Or he may just sit without moving. The feedback provided next is contingent on the type of response the student gives.

One variation of DTT is to provide a prompt along with the discriminative stimulus to encourage errorless learning. Providing a prompt with the discriminative stimulus helps guarantee that the student responds correctly. For example, guiding the student's finger to his nose using a full physical prompt when giving the discriminative stimulus "Touch nose" results in a correct response without allowing for error.

Other types of prompts are useful for reducing or eliminating errors. The teacher may use **blocking** to prevent an incorrect response by restricting

access to incorrect choices, such as covering all but the correct picture when asking the student to identify a particular picture. Within-stimulus prompts provide an exaggeration of relevant components of a stimulus, such as highlighting the word "Name" on students' papers to prompt them to write their names. A carpet freshening powder can be sprinkled on the floor to serve as a visual prompt for the areas left to be vacuumed. Although some advocate for the use of errorless learning (Heckaman, Alber, Hooper, & Heward, 1998), most DTT allows students to perform unassisted the first time, with prompts being given after the response in an error-correction procedure.

Feedback

The teacher provides a consequence after the student responds. If the student's response is correct, the feedback provides reinforcement. If the student is incorrect or gives no response, the feedback corrects the error by prompting the student to respond as directed.

To deliver feedback, identify and have available whatever the student finds reinforcing. The reinforcement must be delivered immediately upon demonstration of a correct response in order to develop the association between the discriminative stimulus and the response. Identifying reinforcers can be tricky for students with ASD. As discussed earlier in this chapter, reinforcement is not a "thing," but an effect. Something is reinforcing only if it maintains or increases the occurrence of a behavior. To identify potential reinforcers, analyze what the student likes and desires. Sometimes this is a particular food or drink, such as raisins or soda. Sometimes the student likes to listen to music or hold a particular object.

Potential reinforcers will be unique to the student. Teachers have reported that students on the autism spectrum have liked things that may seem unusual, such as picking up staples off the floor, holding pieces of laminating film, and smelling socks. Charlop-Christy and Haymes (1998) found that globes, map books, toothpaste caps, coffee swizzle sticks, toy helicopters, and balloons were preferred by the participants in their study. The array of potential reinforcers is endless. Knowing the student is the best way to start to identify potential reinforcers. For some students, identifying potential reinforcers can be particularly challenging because the things they like most do not lend themselves well to a DTT interaction. For example, some students like to go on walks, ride in the car, or swing. The challenge, then, is to try to identify potential reinforcers that do not last too long and that can be delivered in small quantities to avoid **satiation** (being satisfied and not wanting more).

Primary reinforcers that can be given in controlled quantities are ideal, such as a few ounces of soda or a single cheese puff. Wind-up or animated toys that are active for a short duration are also good. When the action stops, there is a logical transition to the next trial. The critical aspect is that the reinforcer is delivered immediately after the correct response occurs.

To identify reinforcers and to verify that the items identified are still relevant as reinforcers, conduct preference assessments (Cannella, O'Reilly, & Lancioni, 2005). This can be as simple as holding out two items and observing which one the student reaches or asks for. Preference assessments can also be more rigorous. For example, identify a number of items and then systematically offer them in pairs to determine the relative order of preference. Then consider what the student has preferred historically and make a judgment about the effect of motivating operations.

Motivating operations affect the relevance of the consequence based on recent experiences (Laraway, Snycerski, Michael, & Poling, 2003). For example, if the student has just finished a large lunch, then food items may be less desirable as reinforcers. However, those same food items may be of great interest to the student if she has not eaten in a while. In providing reinforcement, the teacher must be confident that the consequence delivered after a correct response is something the student desires.

If the student gives an incorrect response or no response at all, the feedback given provides error correction followed by reinforcement. Prompts delivered by another person exist on a hierarchy from least intrusive to more intrusive as follows:

- *Visual:* The teacher shows the student a picture, icon, word, or object representing the desired response.
- *Gestural:* The teacher gestures toward what is to be done.
- *Model:* The teacher performs the expected behavior for the student to watch.
- *Partial physical:* The teacher touches the student to get the requested motion started.
- *Full physical:* The teacher physically guides the student through the performance of the action.

One of the less intrusive prompts, the verbal prompt, has been purposely omitted from this listing. A verbal prompt is not the restatement of the discriminative stimulus. A verbal prompt contains comments that offer additional information. For the discriminative stimulus "Line up!" a verbal prompt might consist of "Stand up and walk to the door." Since most students with ASD have auditory processing difficulties, verbal prompts are contraindicated because they add verbal information that further strains the ability to comprehend.

Initially, the reinforcement for a prompted response is the same as the reinforcement for an independent response. The idea is to teach the student that when the response occurs after a particular instruction (discriminative stimulus), it is followed by something the student finds desirable (reinforcement).

Prompts must be used with caution to avoid prompt dependency. **Prompt dependency** occurs when the student waits for a prompt before responding and is said to be dependent upon the prompt. To avoid prompt dependency, after several trials with prompting, reduce or eliminate the

Discrete Trial Teaching

Student: Nebil Trainer: JT

Objective:	Color identification
Condition:	Sitting across from Nebil and giving him a fidd of 3 options
Sd:	"Touch _____" (fill in blue, red, yellow, green)
Criteria:	80% accuracy with Sd only (no prompting) for three consecutive sessions
Reinforcement Schedule:	(1:1) 1:2 1:3 Intermittent Other:

Date	9/7	Date	9/8	Date	9/9	Date	9/10	Date	9/13
	Prompt		Prompt		Prompt		Prompt		Prompt
~~10~~	F	10		~~10~~	G	(10)		10	
~~9~~	F	9		~~9~~	G	~~9~~	G	9	
~~8~~	F	~~8~~	P	~~8~~	G	~~8~~	P	8	
~~7~~	F	~~7~~	P	~~7~~	G	(7)		7	
~~6~~	F	~~6~~	P	~~6~~	P	(6)		6	
~~5~~	F	~~5~~	P	~~5~~	G	~~5~~	P	(5)	
~~4~~	F	~~4~~	F	~~4~~	P	[4]	G	[4]	
~~3~~	F	~~3~~	P	~~3~~	P	(3)		(3)	
~~2~~	F	~~2~~	F	~~2~~	P	~~2~~	G	~~2~~	G
~~1~~	F	~~1~~	F	~~1~~	P	~~1~~	G	(1)	
0%		0%		0%		40%		80%	
>/ prompt: F 100 %		>/ prompt: P 63 %		>/ prompt: G/P 50 %		>/ prompt: G 66 %		>/ prompt: G 100 %	

Prompts:
G = gestural
M= model
P = partial physical
F = full physical

Marking: ---- incorrect
o correct
□ total correct for session
*If a prompt is used, the trial is marked incorrect.

Comments:

FIGURE 6.2
DTT Data Collection for Nebil

reinforcement. Show but do not give the student the reinforcement after the error correction procedure. The next trial gives the student the opportunity to perform the response independently and receive the reinforcement.

Intertrial Interval

The **intertrial interval** is a brief period of time between trials during which the student enjoys the reinforcement received for a correct response and the teacher records the data for the trial. The intertrial interval is what gives the methodology its name. (The word *discrete* refers to something with a clear beginning and a clear end, and shouldn't be confused with *discreet*, which refers to something secretive or covert.)

After the intertrial interval, ensure that the student is still attending and provide another discriminative stimulus (the same as previously or different). Traditionally, a teacher removed any materials during the intertrial interval so that they could be presented distinctly at the beginning of the next trial. In applied settings, the materials may not always be removed. Intertrial intervals may last a few seconds but can be longer or shorter depending on the student. Indeed, for students with short attention spans or who are difficult to reengage after a break, the intertrial interval may be very brief (Lovaas, 2003). Short intertrial intervals have been shown to increase correct responding while reducing off-task behavior (Dunlap, Dyer, & Koegel, 1983).

If the length of the intertrial interval appropriate for the student allows, the accuracy of the student's response may be recorded during the intertrial interval. Data collection may be as simple as recording a plus if the student has responded correctly or a minus if the student has not responded correctly. More sophisticated forms of data collection record the level of prompting used in the error correction procedure. Figure 6.2 provides an example of a self-graphing data collection sheet that contains complete information about the task and responses. Although most data collection sheets are set up to collect data in sets of 10, that is only for the convenience of converting data to percentages and nothing more.

If a student provides correct responses for three trials in a row, switch to another discriminative stimulus. When asked to demonstrate a response that has already been done correctly several times, the student may become bored or resistant and the response will decay.

❖ LEARNING WITH MS. HARRIS: Teaching Gabe to Label Pictures

The IEP team decides Gabe needs to increase his receptive vocabulary and identify verbs. He is currently using one-word utterances (nouns) to identify things he would like to have. Since learning verbs is critical for language development, Ms. Harris has gathered pictures that portray people performing a variety of common acts (e.g., eating, sleeping, drinking,

washing, running, swinging). Ms. Harris carefully arranged the environment so that she and Gabe could sit at a table in an area free of distractions. Gabe's chair backs up to the wall, so it will be difficult for him to leave the area.

Ms. Harris has several items that she knows Gabe likes. Sitting down at the table, Gabe starts to reach for the candy. Ms. Harris removes all the items from the table but keeps the candy in front of her. After making sure that she has Gabe's attention, Ms. Harris holds up the picture of a person walking and says, "Point to walking." If Gabe fails to respond, Ms. Harris repeats the discriminative stimulus and uses a full physical prompt to help Gabe point to the picture before she gives Gabe a small piece of candy while praising him.

After Gabe reliably points to the pictures when directed, Ms. Harris presents two pictures simultaneously and asks Gabe to point to the one that depicts a particular action. If Gabe correctly discriminates between the two pictures, Ms. Harris reinforces and praises him. If Gabe is incorrect, Ms. Harris repeats the discriminative stimulus and guides Gabe's hand to touch the correct picture. Then she gives him some candy, but watches Gabe closely to see if it looks as if he is waiting for her to prompt him. She certainly doesn't want to create prompt dependence!

Once in a while, Ms. Harris holds up two new items that are potential reinforcers to see which one Gabe might be interested in. If he doesn't reach for or label either one of them, Ms. Harris tries two different items. She knows it is important to vary the reinforcers to prevent Gabe from becoming satiated, which decreases his motivation for responding as requested. Across days and weeks, the series of trials continues until Gabe can correctly identify common verbs when they are presented in a field of three pictures with 90% accuracy over a two-week period and with at least two different teachers.

Variations

There is no controversy regarding the effectiveness of DTT as a basic methodology. However, variations on the basic methodology as well as recommendations regarding different types of DTT have resulted in considerable controversy.

One of the major variations relates to when prompts should be used. Some people recommend students not be prompted after the first incorrect/no response. Instead, after an incorrect/no response, the teacher should say "no," look away, and remove the materials (Lovaas, 2003; Smith, 2001). Others hold the student's hands on the table for a brief period of time after an incorrect/no response (Pérez-González & Williams, 2002). Leaf and McEachin (1999) indicate that students should be allowed to give two incorrect responses before receiving a prompt for the correct response. These variations have led to disagreements regarding which method is most effective for teaching behavioral responses. Unfortunately, research has yet

to be conducted to answer the question of which may be more effective and for whom.

There are also variations in the types of discrete trials. There are three types of discrete trials, with each having advantages and disadvantages: massed, distributed, and collective trials. In **massed trials,** the teacher uses the same discriminative stimulus many times consecutively in order to occasion the same response. An example of a massed discrete trial is asking the student to touch her nose 10 times in a row. The advantage of massed discrete trials is that they are useful for teaching a skill very quickly. The disadvantage is that the information tends to be quickly forgotten. Cramming for an exam is an example of a massed discrete trial. Students who have an exam on Thursday may start studying in earnest on Wednesday night and learn the information sufficiently to pass the exam. However, students cannot remember the information weeks, days, or even hours after taking the exam.

Another disadvantage of massed discrete trials is that people tend to get irritated when asked to perform the same response several times in a row (Koegel & Koegel, 1995). This irritability can manifest as noncompliance or even aggression. Some parents have claimed that the use of massed discrete trials has led to behavioral problems in their children and even symptoms of post-traumatic stress ("Open Letter," 1999).

To avoid resistance and promote greater retention of behavioral responses, trials can be distributed throughout and across days instead of massed. Instead of being asked to touch his nose 10 times in a row (massed trials), the student might be asked to touch his nose once in the morning while brushing his teeth, once when singing a song, once when waiting in line, and so forth (**distributed trials**). Or the trials might be distributed throughout a training session.

Although it will take longer for the student to learn the response with distributed trials, the advantage is that once the student learns the response, particularly if the trials have been distributed across settings and people, he will be more likely to retain it across time (Koegel, O'Dell, & Koegel, 1987; McGee, Krantz, & McClannahan, 1984). In the previous example of cramming for an exam and then forgetting the information, students would have retained much more of that information if they had studied and reviewed it each week of the semester leading up to the exam. Distributed trials have been found to be superior to massed trials when it is important for the information to be retained (Dellarosa & Bourne, 1985; Dempster, 1988; Lee & Genovese, 1988; Reynolds & Glaser, 1964).

A third type of discrete trial is **collective trials,** which distribute the trials across students. This is a common occurrence in classrooms. Students have been given the same assignment and the teacher solicits answers. The teacher asks a student for the answer to the first question (gain attention and present discriminative stimulus). The teacher acknowledges a correct answer and corrects an incorrect answer or calls on someone else to answer (response and consequence provided). Then another student is asked to answer the next question. An advantage of collective trials is sharing the

spotlight. Also, collective trials allow students to learn from each other and benefit from modeling. Disadvantages are that students may not pay attention if they are not being questioned directly, and some students may not notice what others are doing, so they may not learn from the modeling. Distributing trials throughout the day and using different types of trials has been shown to be effective (Egel, Shafer, & Neef, 1984; McMorrow & Foxx, 1986).

PROS AND CONS OF DISCRETE TRIAL TRAINING

DTT is used in almost every learning situation. When a child is learning to speak, a caregiver points to a cat and says, "What's that?" to which the child replies, "Kitty" and is told, "Yes, it is!" (We'll assume that verbal praise from a caregiver increases the child's speaking and is therefore reinforcing.)

As children age, they are exposed to various types of DTT (probably massed for spelling words and multiplication facts) as well as other types of instruction. When analyzing the highly structured type of DTT that has been presented here, there are some pros and cons to take into consideration when deciding on how the methodology may be used in the classroom.

The pros include:

1. Students have many opportunities to learn and practice responses. Since trials are so short, the student could respond up to 12 times per minute (Smith, 2001).
2. The discriminative stimulus is clearly defined and all other distractions are eliminated. This helps the student attend to what is relevant.
3. Important skills are broken down into their discrete parts (task analyzed) so that each component can be specifically taught.
4. Correct behavior is determined in advance and reinforced immediately.
5. The methodology can be replicated across people so that everyone uses the same approach with the student.

In addition to the benefits inherent in highly structured DTT interactions, there are some cautions to consider.

The cons include:

1. Skills learned during massed discrete trials may not generalize to other settings or to people not involved in the training.
2. Exclusive emphasis on DTT may limit learning and result in unwanted side effects. Some students respond to intensive DTT by becoming resistant (Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Newman, Needelman, Reinecke, & Robek, 2002). Additionally, since the goal of DTT is to create stimulus dependency, the emergence of independent and adaptive behaviors may be inhibited (Birnbrauer & Leach, 1993; Rogers, 1999).
3. Stimulus dependency (responding to the discriminative stimulus when it is given, but only when it is given), may result in students learning

the wrong cues for behaviors, such as waiting for the teacher to tell them to play rather than playing in the presence of the toys themselves (Smith, 2001).

4. Some students may benefit more from DTT than others. Students with measured IQs of less than 50 are less likely to benefit from intensive DTT (Anderson et al., 1987; Fenske, Zalenski, Krantz, & McClannahan, 1985; Harris and Handleman, 2000; Lovaas, 1987) than students with IQs above 50.

SUMMARY OF DISCRETE TRIAL TRAINING

Strong empirical evidence supports the effectiveness of a variety of applied behavior analytic interventions. The data on the effectiveness of DTT are less conclusive (Gresham & Macmillan, 1997). Although everyone learns through the process of associating consequences with behaviors in the presence of certain stimuli, providing many hours of massed discrete trial may not produce generalized use of skills and improve adaptive functioning. Researchers have documented that DTT is more effective for younger children (younger than 4 years of age) with IQs above 50 (Lovaas, 1987). Gains equal to or better than those found in the seminal 1987 study by Lovaas have been noted in similar populations who did not receive DTT (Eaves & Ho, 2004; Gabriels, Hill, Pierce, Rogers, & Wehner, 2001), leading to the conclusion that characteristics of the children influenced outcomes more than the intervention (Lord, Cook, Leventhal, & Amaral, 2000). In particular, IQ appears to be the best predictor of responsiveness to intervention (Eikeseth, Smith, Jahr, & Eldevik, 2002).

As the NRC (2001) noted, family characteristics as well as child characteristics may confound research findings. Howard et al. (2005) found that intensive DTT was not effective for everyone; some students across all three of their comparison groups made progress. Students in their intensive DTT group made the most progress but were differentiated in terms of their families. The researchers used intact groups of children who were receiving intervention at three locations (private intensive DTT, public special education classroom, and public early intervention program), which indicates that the children were not living in similar home environments. As would be predicted, the parents who placed their children in the intensive DTT program had 1–2 more years of education than the parents in the other two groups. The children in the intensive DTT program had been diagnosed younger and had started intervention sooner. Four children originally in the intensive DTT group dropped out of the study; two because the intervention led to behavior problems and the parents chose to discontinue, one because the parent could not provide the home programming, and one whose family moved. Attrition in the two comparison groups occurred for different reasons. Of the four children who dropped out, one parent refused to allow testing at follow-up and three parents could not be contacted. The parents in the three groups also differed in

terms of ethnicity and marital status, with almost half in the public early intervention program being unmarried. More analysis needs to be done to determine how family demographics influence response to intervention, including intensive DTT.

Some of the problems with early programs using DTT, such as cue dependency, lack of self-initiation, rote responding, and failure to generalize (Schreibman, 2000), have led to modifications in the methodology. For example, Smith, Eikeseth, Klevstrand, and Lovaas (1997) added a component of parent training to try to minimize some of the concerns. At the end of one year, no statistically significant differences were noted between a group of students receiving DTT and those receiving an "eclectic" special education program (Eikeseth et al., 2002). Intensive DTT has been found to accelerate learning but not to cure individuals of their autism (Rogers, 1998). This leads to the conclusion that:

> DTT is a necessary but not sufficient element of ABA treatment for children with autism. . . . other instructional approaches [will be needed to teach them how to] initiate the use of the skills they have acquired, transfer those skills to new settings, and reduce their reliance on cues from the teacher. (Smith, 2001, p. 91)

OTHER EFFECTIVE ABA INTERVENTIONS

Over the last thirty years, thousands of studies have been published that demonstrate the effectiveness of applied behavior analytic procedures for changing behavior in persons with and without disabilities in home, school, and community settings. Some of these procedures have been studied specifically with individuals with ASD. This book profiles many of the applied behavior analytic procedures used effectively with students on the autism spectrum. Chapter 4 describes applied behavior analytic interventions related to environmental arrangement and manipulation, the use of static and animated visual strategies, priming, choice making, and establishing stimulus control.

Chapter 7 describes the applied behavior analytic approach to support adaptive behavior by determining behavioral function and designing positive behavioral supports. That chapter discusses Pivotal Response Training (PRT) and Functional Communication Training (FCT), which meet the five dimensions of ABA. Chapter 8 discusses applied behavior analytic interventions for promoting the development of communication and verbal behavior through such procedures as incidental teaching, Natural Language Paradigm (NLP), Joint Action Routines (JARS), and Picture Exchange Communication System (PECS).

Chapter 9 describes applied behavior analytic strategies for supporting social development in the forms of peer-mediated and adult-mediated approaches. Chapters 10 and 11 discuss the application of applied behavior analytic interventions to support skill acquisition in academic content areas as well as those based on promoting engagement.

❖ LEARNING WITH MS. HARRIS: An Answer for Ms. Nelson

After great reflection, Ms. Harris sends Andy's mother the following e-mail:

Hi! Andy had a great day today, as you can tell from the work that was sent home! During centers, he traded seven objects with three different peers.

By the way, you asked if I could do ABA with Andy. You'll be happy to know that the majority of Andy's day is spent in applied behavior analytic (ABA) instruction. Even the PECS you're using at home is an applied behavior analytic strategy (as is that toilet training program we talked about).

You'll probably be pleased to know that some of Andy's instruction is provided in the form of Discrete Trial Training. Rather than using massed trials, I use distributed and collective trials. I'm using these to support Andy's use of the skills he is learning in other settings and with other people. We learned the lesson the hard way that when I practiced "What's your name?" with Andy over and over, he became good at answering me, but he didn't answer anyone else who asked him! Distributed trials are more likely to be maintained over time and are less likely to interfere with Andy's adaptive behavior development.

As hard as we're all working, we want to make sure to use approaches that provide the most benefit. Andy is making good progress through the use of a variety of applied behavior analytic strategies!

Hope you all have a great weekend! Ms. H

CONCLUSION

Interventions based on the principles of applied behavior analysis have strong empirical data to support their effectiveness with students with ASD. To be considered an ABA approach, the intervention must meet specified criteria related to social significance and contextual considerations affecting the generalized adaptability of behavior. Interventions based on ABA must be validated through collection of data that demonstrate their impact on the behavior. DTT is one of the many ABA interventions that have been used with students with ASD. DTT is effective for promoting skill acquisition but has limitations that necessitate that it be used in combination with other ABA interventions in order to teach important and relevant skills with generalized use to students with ASD.

DISCUSSION QUESTIONS AND ACTIVITIES

1. At an IEP meeting a parent turns to you and says, "I want you to do ABA with my child!" What do you say?
2. Identify a research article that describes an intervention that modified the behavior of a student with an ASD. Compare the intervention against the five dimensions of ABA and determine how adequately it meets all criteria.

3. Think of at least five skills you have learned using DTT. Describe how each of the five steps occurred in your experiences.
4. Most behavior is learned through the power of reinforcement. Describe a variety of strategies you could use to conduct reinforcer assessments with your students.
5. Discuss what needs to occur during and after instruction to enhance the student's ability to generalize the skills being learned.

REFERENCES

Alber, S. R., Heward, W. L., & Hippler, B. J. (1999). Teaching middle school students with learning disabilities to recruit positive teacher attention. *Exceptional Children, 65,* 253-270.

Alberto, P. A., & Troutman, A. C. (2003). *Applied behavior analysis for teachers* (6th ed.). Upper Saddle River, NJ: Merrill/ Prentice Hall.

Anderson, G. M., Freedman, D. X., Cohen, D. J., Volkmar, F. R., Hoder, E. L., McPhedran, P., et al. (1987). Whole blood serotonin in autistic and normal subjects. *Journal of Child Psychology & Psychiatry & Allied Disciplines, 28,* 885-900.

Anderson, S. R., & Romanczyk, R. G. (1999). Early intervention for young children with autism: Continuum-based behavioral models. *Journal of the Association for Persons with Severe Handicaps, 24,* 162-173.

Anderson, S. R., Taras, M., & Cannon, B. O. (1996). Teaching new skills to young children with autism. In C. Maurice (Ed.), *Behavioral intervention for young children with autism: A manual for parents and professionals* (pp. 181-194). Austin, TX: Pro-Ed.

Baer, D. M., Wolf, M. M., & Risley, T. (1968). Current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1,* 91-97.

Baer, D. M., Wolf, M. M., & Risley, T. (1987). Some still-current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 20,* 313-328.

Birnbrauer, J. S., & Leach, D. J. (1993). The Murdoch Early Intervention Program after 2 years. *Behaviour Change, 10,* 63-74.

Brady, M. P., Shores, R. E., McEvoy, M. A., Ellis, D., & Fox, J. J. (1987). Increasing social interactions of severely handicapped autistic children. *Journal of Autism and Developmental Disorders, 17,* 375-390.

Cannella, H. I., O'Reilly, M. F., & Lancioni, G. E. (2005). Choice and preference assessment research with people with severe to profound developmental disabilities: A review of the literature. *Research in Developmental Disabilities, 26,* 1-14.

Carr, J. E., Dozier, C. L., Patel, M., Adams, A. N., & Martin, N. (2002). Treatment of automatically reinforced object mouthing with noncontingent reinforcement and response blocking: Experimental analysis and social validation. *Research in Developmental Disabilities, 23,* 37-44.

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18,* 111-126.

Charlop, M. H., & Milstein, J. P. (1989). Teaching autistic children conversational speech using video modeling. *Journal of Applied Behavior Analysis, 22,* 275-285.

Charlop-Christy, M. H., & Haymes, L. K. (1998). Using objects of obsession as token reinforcers for children with autism. *Journal of Autism and Developmental Disorders, 28,* 189-198.

Dellarosa, D., & Bourne, L. E. (1985). Surface form and the spacing effect. *Memory and Cognition, 13,* 529-537.

Dempster, F. N. (1988). The spacing effect: A case study in the failure to apply the results of psychological research. *American Psychologist, 43,* 627-634.

Dunlap, G., Dyer, K., & Koegel, R. L. (1983). Autistic self-stimulation and intertrial interval duration. *American Journal of Mental Deficiency, 88,* 194-202.

Dunlap, G., Kern, L., & Worcester, J. (2001). ABA and academic instruction. *Focus on Autism and Other Developmental Disabilities, 16,* 129-136.

Dunlap, G., Marshall, U., Plienis, A. J., & Williams, L. (1987). Acquisition and

generalization of unsupervised responding: A descriptive analysis. *Journal of the Association for Persons with Severe Handicaps, 12,* 274–279.

Durand, V. M. (2005). Past, present, and emerging directions in education. In D. Zager (Ed.), *Autism spectrum disorders* (3rd ed., pp. 89–109). Mahwah, NJ: Erlbaum.

Eaves, L. C., & Ho, H. H. (2004). The very early identification of autism: Outcome to age 4–5. *Journal of Autism and Developmental Disorders, 34,* 367–378.

Egel, A. L., Shafer, M. S., & Neef, N. A. (1984). Receptive acquisition and generalization of prepositional responding in autistic children: A comparison of two procedures. *Analysis and Intervention in Developmental Disabilities, 4,* 285–298.

Eikeseth, S., Smith, T., Jahr, E., & Eldevik, S. (2002). Intensive behavioral treatment at school for 4- to 7-year-old children with autism. *Behavior Modification, 26,* 49–68.

Fenske, E. C., Zalenski, S., Krantz, P. J., & McClannahan, L. E. (1985). Age at intervention and treatment outcome for autistic children in a comprehensive intervention program. *Analysis and Intervention for Developmental Disabilities, 5,* 49–58.

Ferrari, M., & Harris, S. L. (1981). The limits and motivating potential of sensory stimuli as reinforcers for autistic children. *Journal of Applied Behavior Analysis, 14,* 339–343.

Frea, W. D. (2000). Behavioral interventions for children with autism. In J. Austin & J. E. Carr (Eds.), *Handbook of applied behavior analysis* (pp. 247–273). Reno, NV: Context Press.

Gabriels, R. L., Hill, D. E., Pierce, R. A., Rogers, S. J., & Wehner, B. (2001) Predictors of treatment outcome in young children with autism. *Autism, 5,* 407–429.

Garfinkle, A. N., & Schwartz, I. S. (2002). Peer imitation: Increasing social interactions in children with autism and other developmental disabilities in inclusive preschool classrooms. *Topics in Early Childhood Special Education, 22,* 26–38.

Grandin, T. (1996). Brief report: Response to National Institutes of Health Report. *Journal of Autism and Developmental Disabilities, 26,* 185–187.

Green, G. (2001). Behavior analytic instruction for learners with autism: Advances in stimulus control technology. *Focus on Autism and Other Developmental Disabilities, 16,* 72–86.

Gresham, F. M., & Macmillan, D. L. (1997). Autistic recovery? An analysis and critique of the empirical evidence on the early intervention project. *Behavioral Disorders, 22,* 185–201.

Hall, L. J., McClannahan, L. E., & Krantz, P. J. (1995). Promoting independence in integrated classrooms by teaching aides to use activity schedules and decreased prompts. *Education & Training in Mental Retardation & Developmental Disabilities, 30,* 208–217.

Haring, T., Kennedy, C., Adams, M., & Pitts-Conway, V. (1987). Teaching generalization of purchasing skills across community settings to autistic youth using videotape modeling. *Journal of Applied Behavior Analysis, 20,* 89–96.

Harris, S. L., & Handleman, J. S. (2000). Age and IQ at intake as predictors of placement for young children with autism: A four- to six-year follow-up. *Journal of Autism and Developmental Disorders, 30,* 137–142.

Heckaman, K. A., Alber, S., Hooper, S., & Heward, W. L. (1998). A comparison of least-to-most prompts and progressive time delay on the disruptive behavior of students with autism. *Journal of Behavioral Education, 8,* 171–201.

Heflin, L. J., & Alberto, P. A. (2001). Establishing a behavioral context for learning with students with autism. *Focus on Autism & Other Developmental Disabilities, 16,* 93–101.

Howard, J. S., Sparkman, C. R., Cohen, H. G., Green, G., & Stanislaw, H. (2005). A comparison of intensive behavior analytic and eclectic treatments for young children with autism. *Research in Developmental Disabilities, 26,* 359–383.

Hung, D. W. (1978). Using self-stimulation as reinforcement for autistic children. *Journal of Autism and Childhood Schizophrenia, 8,* 355–366.

Johnston, S., & O'Neill, R. E. (2001). Searching for effectiveness and efficiency in conducting functional assessments: A review and proposed process for teachers and other practitioners. *Focus on Autism and Other Developmental Disabilities, 16,* 205–214.

Kamps, D. M., Leonard, B. R., Vernon, S., Dugan, E., Delquadri, J. C., Gershon, B., et al.